Nuclear Instruments and Methods in Physics Research A 347 (1994) xi–xvii
North-Holland

NUCLEAR
INSTRUMENTS
& METHODS
IN PHYSICS
RESEARCH
Section A

Contents

Foreword vii
Donald R. Mueller (1958–1994) viii
Committees ix

Section I. Historical milestones

The early years of synchrotron radiation research at NBS-SURF
K. Codling 1
The international development of synchrotron radiation research – a view from Japan
T. Sasaki 9
Synchrotron radiation: 30 years of a fruitful collaboration between the United States and Europe
R. Haensel 14
Development of synchrotron radiation photoemission from photoionization to electron holography
G.J. Lapeyre 17

Section II. Facility reports

Operating experience with the Helios compact storage ring at IBM
J.P. Silverman, C.N. Archie, D.E. Andrews and A.J. Weger 31
A status update on the Advanced Photon Source Project – summer 1993
D.E. Moncton and R.B. Fenner 39
The Stanford Synchrotron Radiation Laboratory – 20 years of synchrotron light
K. Cantwell 44
SRC: Current activities and plans for the future
D.L. Huber, M.A. Green, R. Hansen, H. Höchst, R. Reininger, E. Rowe, W. Trzeciak and B.P. Tonner 49
Status of the Pohang Light Source project
S.Y. Rah, W. Namkung, Y.-s. Kim and T.-N. Lee 52

Section III. Wigglers and undulators

Computer simulations of the wiggler spectrum
R.J. Dejus 56
Program UR: general purpose code for synchrotron radiation calculations
R.J. Dejus and A. Luccio 61
Design of the Advanced Light Source elliptical wiggler
C.-X. Wang, R. Schlueter, E. Hoyer and P. Heimann 67
A high-power and high-flux X-ray wiggler station at the Cornell High Energy Synchrotron Source
P. Doing, J. White and Qun Shen 73
An elliptically-polarizing undulator with phase adjustable energy and polarization
S. Lidia and R. Carr 77
Analyses for a planar variably-polarizing undulator
S. Sasaki 83

0168-9002/94/$07.00 © 1994 – Elsevier Science B.V. All rights reserved

First observation of undulator radiation from APPLE-1
S. Sasaki, T. Shimada, K.-i. Yanagida, H. Kobayashi and Y. Miyahara 87
Optimization of circularly-polarized radiation from an elliptical wiggler, asymmetric wiggler, or bending magnet
C.-X. Wang and R. Schlueter 92
Two new insertion devices for Aladdin
F.C. Younger, W. Jorge Pearce and B. Ng 98
Test of a new model pole assembly for an Advanced Photon Source undulator
S. Xu and J. Maines 102

Section IV. Optics for elliptical polarization

Multiple-reflection $\lambda/4$ phase shifter: a viable alternative to generate circular-polarized synchrotron radiation
H. Höchst, R. Patel and F. Middleton 107
Whispering galleries for the production of circularly polarized synchrotron radiation in the XUV region
N.V. Smith and M.R. Howells 115
Spherical-grating monochromator system with circular-polarization capability for the U5U undulator at Brookhaven
N.V. Smith, S.L. Hulbert, P.D. Johnson and J.L. Erskine 119
A multi-purpose polarimeter for X-ray studies
K.D. Finkelstein, C. Staffa and Qun Shen 124
Germanium X-ray phase plates for the production of circularly polarized X-rays
C.J. Yahnke, G. Srajer, D.R. Haeffner, D.M. Mills and L. Assoufid 128

Section V. Circular dichroism

Soft X-ray magnetic circular dichroism and magnetic films
Y.U. Idzerda, C.T. Chen, H.-J. Lin, G. Meigs, G.H. Ho and C.-C. Kao 134
Imaging magnetic domains with the X-ray dichroism photoemission microscope
B.P. Tonner, D. Dunham, J. Zhang, W.L. O'Brien, M. Samant, D. Weller, B.D. Hermsmeier and J. Stöhr 142
A system for magnetic circular dichroism measurements with a 10 m toroidal grating monochromator
R.W.C. Hansen, W.L. O'Brien and B.P. Tonner 148
Mott electron polarimetry
F.B. Dunning 152

Section VI. Coherence

Coherence effects from visible light to X-rays
E. Spiller 161
The future of X-ray holography
I. McNulty 170
Intensity interferometry at the X13A undulator beamline
E. Gluskin, I. McNulty, L. Yang, K.J. Randall, Z. Xu and E.D. Johnson 177
Toward a soft X-ray Fourier-transform spectrometer
M.R. Howells, K. Frank, Z. Hussain, E.J. Moler, T. Reich, D. Möller and D.A. Shirley 182
Concepts for ultraviolet-free electron laser optics
E.D. Johnson 192

Short wavelength FELs using the SLAC linac
H. Winick, K. Bane, R. Boyce, J. Cobb, G. Loew, P. Morton, H.-D. Nuhn, J. Paterson, P. Pianetta, T. Raubenheimer, J. Seeman, R. Tatchyn, V. Vylet, C. Pellegrini, J. Rosenzweig, G. Travish, D. Prosnitz, E.T. Scharlemann, K. Halbach, K.-J. Kim, R. Schlueter, M. Xie, R. Bonifacio, L. De Salvo and P. Pierini 199

Section VII. VUV optics

The use of diffraction efficiency theory in the design of soft X-ray monochromators
H.A. Padmore, V. Martynov and K. Holis 206
The differential method for grating efficiencies implemented in Mathematica™
V.S. Valdes, W.R. McKinney and C. Palmer 216
Water-cooled ion-milled diffraction gratings for the synchrotron radiation community
W.R. McKinney, C.L. Shannon and E.N. Shults 220
Improved measurement accuracy in a long trace profiler: compensation for laser pointing instability
S.C. Irick 226
Design of an aspheric mirror for synchrotron radiation X-ray lithography beamline
J. Xiao and F. Cerrina 231
Applications of faceted mirrors to X-ray lithography beamlines
G.-J. Chen, J.Z.Y. Guo and F. Cerrina 238
Transmission grating spectrometer for characterization of undulator radiation
D.A. Mossessian, P.A. Heimann, E. Gullikson, R.K. Kaza, J. Chin and J. Akre 244
Cleaning of optical surfaces with photogenerated reactants
R.W.C. Hansen, J. Wolske, D. Wallace and M. Bissen 249
UV/ozone cleaning of a replica grating
R.W.C. Hansen, J. Wolske and P.Z. Takacs 254
Variable groove spaced grating monochromators for synchrotron light sources
M. Haass, J.J. Jia, T.A. Callcott, D.L. Ederer, K.E. Miyano, R.N. Watts, D.R. Mueller, C. Tarrio and E. Morikawa 258
Combining rotation and translation in a variable line space high-resolution soft-X-ray monochromator: design requirements and performance evaluation of a novel grating mount
M.V. Fisher, N. Steinhauser, D. Eisert, B. Winter, B. Mason, F. Middelton and H. Höchst . . . 264
A high-resolution variable-line-spacing spherical-grating monochromator with a movable exit slit
R. Reininger and M. Bissen 269
A new optical design method and its application to an extreme ultraviolet varied line spacing plane grating monochromator
M. Koike, R. Beguiristain, J.H. Underwood and T. Namioka 273
An optimized undulator beamline for high-resolution photoemission valence band spectroscopy
C.G. Olson and D.W. Lynch 278
VUV high resolution and high flux beamline for chemical dynamics studies at the Advanced Light Source
M. Koike, P.A. Heimann, A.H. Kung, T. Namioka, R. DiGennaro, B. Gee and N. Yu 282
The very high resolution spectrometer at the National Institute of Standards and Technology
H.D. Morgan, J.D.E. Fortna, H.M. Seyoum, M.L. Furst, L.R. Hughey, D.C. Humm and A. Asfaw 287
Dual grating monochromator for detector calibrations using synchrotron radiation as an absolute source at NIST
R.E. Vest, L.R. Canfield, M.L. Furst, R.P. Madden and N. Swanson 291
Improved resolution and flexibility of the SURF II high-throughput 2-m normal-incidence monochromator
L.R. Hughey 294

Preliminary performance and experiments from the high resolution plane grating monochromator at the Center for Advanced Microstructures and Devices
Z. Qu, K. Subramanian, N. Mainkar, A. Goonewardene, T. Campbell, S. Kakar, R.L. Kurtz, R.L. Stockbauer, A. Mihill and V. Saile 299
A plane grating monochromator for the new undulator at Aladdin: 8–240 eV
R. Reininger, S.L. Crossley, M.A. Lagergren, M.C. Severson and R.W.C. Hansen 304
An infrared synchrotron radiation beamline on DAΦNE
E. Burattini, G. Cappuccio, A. Marcelli, P. Calvani, A. Nucara and M. Sánchez del Río 308

Section VIII. X-ray optics

Asymmetric-cut monochromator with adjustable asymmetry
R.K. Smither and P.B. Fernandez 313
Modifications to the 1989 SHADOW ray-tracing code for general asymmetric perfect-crystal optics
R.C. Blasdell and A.T. Macrander 320
Weak polarization effects for an inclined crystal monochromator
A.T. Macrander and R.C. Blasdell 324
A ray-tracing study of inclined double-crystal monochromators
R.C. Blasdell, A.T. Macrander and W.K. Lee 327
A criterion for the dynamical-to-kinematical transition in X-ray diffraction by a bent crystal
V.I. Kushnir and A.T. Macrander 331
Modeling perfect crystals in transmission geometry for synchrotron radiation monochromator design
M. Sánchez del Río, C. Ferrero, G.-J. Chen and F. Cerrina 338
SHADOW: a synchrotron radiation and X-ray optics simulation tool
C. Welnak, G.J. Chen and F. Cerrina 344
High-resolution, large-angular-acceptance monochromator for hard X rays
T.M. Mooney, T. Toellner, W. Sturhahn, E.E. Alp and S.D. Shastri 348
A compact double-crystal monochromator with a broad energy range
J.-L. Staudenmann and R.D. Deslattes 352
Mechanical design of a high-resolution tunable crystal monochromator for the Multiple Energy Computed Tomography project
M. Shleifer, F.A. Dilmanian, F.A. Staicu and M.H. Woodle 356
Performance of InSb/KDP monochromator crystal pair
B.A. Karlin, J.C. Woicik and P.L. Cowan 360
Soft X-ray Foucault test: a path to diffraction-limited imaging
A.K. Ray-Chaudhuri, W. Ng, S. Liang and F. Cerrina 364
Double-moment Kirkpatrick–Baez condensing mirrors: in situ alignment
J. Welnak, A.K. Ray-Chaudhuri, W. Ng and F. Cerrina 372

Section IX. Capillary optics

Polycapillary-based X-ray optics
Q.F. Xiao and S.V. Poturaev 376
Developments in tapered monocapillary and polycapillary glass X-ray concentrators
S.A. Hoffman, D.J. Thiel and D.H. Bilderback 384
A capillary concentrator for an X-ray microprobe
K.F. Voss, K.H. Kim, E.A. Stern, F.C. Brown and S.M. Heald 390
Guiding hard X rays with glass polycapillary fiber
Q.F. Xiao, I.Yu. Ponomarev, A.I. Kolomitsev, D.M. Gibson, F.A. Dilmanian and E. Nachaliel . 397

Potential for concentration of synchrotron beams with capillary optics
J.B. Ullrich, W.M. Gibson, M.V. Gubarev, C.A. MacDonald and Q.-F. Xiao 401
Ray-tracing of X-ray focusing capillaries
G.-J. Chen, F. Cerrina, K.F. Voss, K.H. Kim and F.C. Brown 407

Section X. Microprobe and microanalysis

Synchrotron X-ray fluorescence microprobe: a microanalytical instrument for trace element studies in geochemistry, cosmochemistry, and the soil and environmental sciences
S.R. Sutton, M.L. Rivers, S. Bajt, K. Jones and J.V. Smith 412
Wide band-pass approaches to total-reflection X-ray fluorescence using synchrotron radiation
S. Brennan, W. Tompkins, N. Takaura, P. Pianetta, S.S. Laderman, A. Fischer-Colbrie, J.B. Kortright, M.C. Madden and D.C. Wherry 417
High resolution spectromicroscopy with MAXIMUM: photoemission spectroscopy reaches the 1000 Å scale
W. Ng, A.K. Ray-Chaudhuri, S. Liang, S. Singh, H. Solak, J. Welnak, F. Cerrina, G. Margaritondo, J.H. Underwood, J.B. Kortright and R.C.C. Perera 422
Micro-XANES: chemical contrast in the scanning transmission X-ray microscope
X. Zhang, H. Ade, C. Jacobsen, J. Kirz, S. Lindaas, S. Williams and S. Wirick 431
Sub-micron spatial resolution of a micro-XAFS electrostatic microscope with bending magnet radiation: performance assessments and prospects for aberration correction
B.P. Tonner and D. Dunham 436
Evaluation of aberration coefficients of practical electrostatic lenses for X-ray absorption microspectroscopy and imaging
D. Dunham, D.M. Desloge, G.F. Rempfer, W.P. Skoczylas and B.P. Tonner 441

Section XI. VUV techniques

Auger, zero-energy photoelectron, coincidence spectroscopy: chemical-site-selective Auger electron spectroscopy
K. Lee, S.L. Hulbert, P. Kuiper, D. Ji and D.M. Hanson 446
A time-of-flight spectrometer for energy-resolved, Auger-electron, multiple-ion coincidence spectrometry
C.-I. Ma, K. Lee, D. Ji, D.Y. Kim and D.M. Hanson 453
High-resolution and high-sensitivity instrumentation for detection of visible–ultraviolet luminescence from products of core-hole decay
M. Mahalingam, K. Lee, D. Ji and D.M. Hanson 457
An experimental approach to elucidating selective solid-state photochemistry induced by monochromatic X-rays
S. Sambasivan, P.A. Hintz, S.L. Anderson and D.M. Hanson 462
The Center for X-ray Lithography facility status and beamlines development
G.M. Wells, E.L. Brodsky, M. Reilly, J.W. Taylor and F. Cerrina 466
An optics free spectrometer for the extreme ultraviolet
D.L. Judge, M.D. Daybell, J.R. Hoffman, M.A. Gruntman, H.S. Ogawa and J.A.R. Samson . . 472
Angular instrument response for photoelectron diffraction using focused, plane-polarized synchrotron beams
J.D. Denlinger, J. Zhang and B.P. Tonner 475

Section XII. X-ray techniques

The X-ray tomographic microscope: three-dimensional perspectives of evolving microstructures
J.H. Kinney, D.L. Haupt, M.C. Nichols, T.M. Breunig, G.W. Marshall, Jr. and S.J. Marshall . . 480

Ultra-small-angle X-ray scattering to bridge the gap between visible light scattering and standard small-angle scattering cameras
A.J. Allen, P.R. Jemian, D.R. Black, H.E. Burdette, R.D. Spal, S. Krueger and G.G. Long . . . 487

A novel small-angle scattering camera design using multiple-beam diffraction
R. Pahl . . . 491

On the collection of diffraction data simultaneously over a range of energy
K.D. Finkelstein and M. Sutton . . . 495

Electron-ion-X-ray spectrometer system
S.H. Southworth, M.A. MacDonald, T. LeBrun and R.D. Deslattes . . . 499

Compton-electron spectroscopy using high-energy synchrotron X-rays
N.A. Guardala, J.L. Price, D.J. Land, D.G. Simons, D.H. Lee, B.M. Johnson, G.A. Glass and J.G. Brennan . . . 504

Grazing incidence X-ray photoemission and its implementation on synchrotron light source X-ray beamlines
T. Jach, M.J. Chester and S.M. Thurgate . . . 507

Exotic sources of X-rays for iodine K-edge angiography
R. Carr . . . 510

A compact radiation source for digital subtractive angiography
H. Wiedemann, M. Baltay, R. Carr, M. Hernandez and W. Lavender . . . 515

Section XIII. Advanced detectors

Charge injection device (CID) technology – a solution for photon and particle imaging applications
R. Wentink and J. Carbone . . . 522

CCD X-ray detectors: opportunities and challenges
R. Clarke . . . 529

Characterization of CCD-based imaging X-ray detectors for diffraction experiments
I. Naday, S. Ross, M. Kanyo, E. Westbrook and M. Westbrook . . . 534

The 150 ns detector project: prototype preamplifier results
W.K. Warburton, S.R. Russell and S.A. Kleinfelder . . . 539

A 1200 element detector system for synchrotron-based coronary angiography
A.C. Thompson, W.M. Lavender, D. Chapman, N. Gmür, W. Thomlinson, V. Rosso, C. Schulze, E. Rubenstein, J.C. Giacomini, H.J. Gordon and J.P. Dervan . . . 545

Section XIV. Storage ring and beamline technology

Transverse coupled bunch instabilities in low-energy injection storage rings
M. Nakajima, K. Yamada and T. Hosokawa . . . 553

Direct observation of individual SPEAR electron bunch orbit oscillations at frequencies above 30 kHz
W.K. Warburton and S.R. Russell . . . 557

Tests of planar permanent magnet multipole focusing elements
J. Cobb and R. Tatchyn . . . 562

Measurements and modelling of undulator radiation with a filter–photodiode detector
M.A. Green, B.D. McVey, W.S. Trzeciak, R. Tatchyn, R.W.C. Hansen and A. Filipponi . . . 568

Realization of a spectral radiance scale in the 40–250 nm spectral region based on a TROLL-type synchrotron
S.I. Anevsky, A.E. Vernyi, V.B. Khromchenko, V.S. Panasyuk and V.I. Sapritsky . . . 573

The Advanced Photon Source X-ray transmitting beam-position-monitor tests at the National Synchrotron Light Source X-25 beamline
D. Shu, J.T. Collins, J. Barraza and T.M. Kuzay . . . 577

Evaluation of an optical beam-position-monitor system with closed-loop steering capabilities
M. Bissen, G. Rogers, W. Wood, D. Eisert, K.J. Kleman, W. Winter and H. Höchst 581
General layout design for the Advanced Photon Source beamline front ends
D. Shu and T.M. Kuzay 584
Front end support systems for the Advanced Photon Source
J. Barraza, D. Shu and T.M. Kuzay 591
Ring beamlines and instrumentation for industrial applications
W. Jorge Pearce and A.P. Trippe 598
National Synchrotron Light Source beam line data acquisition and analysis computer system
S.K. Feng-Berman, D.P. Siddons and L. Berman 603

Section XV. High-heat-load techniques

High-heat-load crystal optics experiments at the NSLS X25 X-ray wiggler beam line
L.E. Berman 607
Design of beam line components for the high power wiggler beam line at CHESS
Qun Shen, C. Henderson, M. Keeffe, M. Marston, K.D. Finkelstein and B.W. Batterman 609
Modifications to improve entrance slit thermal stability for grasshopper monochromators
D.J. Wallace, G.C. Rogers and S.L. Crossley 615
High heat load X-ray optics research and development at the Advanced Photon Source – an overview
W.-K. Lee and D.M. Mills 618
Postbuckling behavior of windows subjected to synchrotron radiation X-rays
Z. Wang, T.M. Kuzay and S.K. Sharma 627
Filter and window behavior for the Advanced Photon Source beamline front ends
Z. Wang, T.M. Kuzay, U. Hahn, D. Shu, R. Dejus and C. Brite 631
Apparent temperature versus true temperature of silicon crystals as a function of their thickness using infrared measurements
R.K. Smither and P.B. Fernandez 640
A review of thermo-mechanical considerations of high temperature materials for synchrotron applications
T.M. Kuzay 644
Low-cycle-fatigue behavior of copper materials and their use in synchrotron beamline components
Z. Wang, T. Nian, D. Ryding and T.M. Kuzay 651
Thermo-mechanical analysis of fixed mask 1 for the Advanced Photon Source insertion device front ends
H.L.T. Nian, D. Shu, I.C.A. Sheng and T.M. Kuzay 657

Author index 665